# 3.—The Enchytraeidae (Oligochaeta) of South Western Australia: The Genus Fridericia Michaelsen 1889.

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**Abstract**

Three new species of Enchytraeidae, *Fridericia giniata F. holmesa* and *F. cylindrica*, are described. Two previously described species, *F. bulbosa* and *F. bulboides*, are recorded from Australia for the first time.

## Introduction

Enchytraeid worms have been collected from some forest soils in the south west of Western Australia. Several of the worms belong to the genus *Fridericia* Michaelsen 1889. The genus was established in 1889 when Michaelsen discovered that certain species then asssigned to *Enchytraeus*, and *Neoenchytraeus*, had definite characters in common which were of sufficient importance to justify the establishment of a new genus.

The only previous record of the genus in Western Australia is that of *F. galba* (Hoffmeister) collected by Michaelsen (1907) in Albany. The worm is common in Europe; in Albany it was found only in gardens and plant pots and Michaelsen (loc. cit.) concludes that it was introduced.

Sample sites and methods

Worms were hand-sorted from soil cores taken from the following sample sites in August, 1969 and identified using the techniques described by Nielsen and Christensen, 1959.

Site 1 Forests Department *Pinus pinaster* plantation Gleneagle, Lat. 32° 17′ S., long. 116° 8′ E.

Site 2 C.S.I.R.O. experimental apple orchard Bedfordale, Lat. 32° 12′ S., long. 116° 8′ E.

Site 3 The banks of Beedelup Brook approximately 50m below Beedelup Falls, Lat. 34° 25′ S., long. 115° 51′ E.

Site 4 Mixed Jarrah Forest adjacent to orchards near Donnybrook, Lat. 33° 40′ S., long. 115° 52′ E.

## Descriptions of New Species

*Fridericia giniata* n.sp. (Figs. 1, 2).

A medium sized grey-white worm 15-20mm long with 59-76 segments. Cutaneous glands arranged in 4-7 rows per segment but only 1 or 2 of these distinct. Clitellum extends over XII-½XIII, the glands not arranged in regular rows. Setal bundles contain 2 setae with a distinct ental hook, maximum length of setae 50 $\mu$. Numbers of loose setae in the coelom. Peptonephridia long with two or three branches in V and two or three terminal branches in VII. Dorsal pores present from VII. Dorsal blood vessel arises in XVII to XIX. Seminal vesicle not developed and the sperm funnel twice as long as broad. Spermathecae large, the ampulla being about 130 $\mu$ in diameter. No diverticula and the ental ducts open separately into the lateral part of the oesophagus in segment V. Ectal duct of medium length with no glands at the ectal orifice. Efferent duct of the nephridum almost terminal.

Chromosome number—32.

*Material examined:* About 150 specimens. of which 98 were mature.

*Distribution:* Sites 1 and 2. Holotype and paratype collected from site 2—Bedfordale, Lat. 32° 12′ S., long. 116° 8′ E. Holotype and paratype specimens deposited in the West Australian Museum (5-69, 6-69).

*Discussion.*—Of the previously described bisetose *Fridericia* species with no spermathecal diverticula, this species is most easily confused with *F. bulbosa* (Rosa 1887) Nielsen and Christensen 1959. *F. giniata* is a larger species both in actual length and in the number of segments. The spermathecae differ from those of *F. bulbosa* in having no glands at the ectal orifice and are more nearly like those of *F. callosa* (Eisen 1878) Nielsen and Christensen 1959. The larger size of *F. giniata*, the smaller number of setae, the presence of detached setae, the absence of a seminal vesicle and the long peptonephridia with few branches distinguish it from *F. callosa*.

Other species with which *F. giniata* shows some affinities are *F. bollonsi* Benham 1914, recorded from the Kermadec Islands, *F. parva* Moore 1895, recorded "in fallen leaves" from Philadelphia, U.S.A. and *F. alba* Moore 1895, recorded "in wet moss" from Philadelphia, U.S.A. *F. giniata* differs from *F. bollonsi* in size and number of segments, the length and shape of the peptonephridia and the absence of a seminal vesicle, and from *F. parva* in size, the number of segments, the number of setae, the shape of the peptonephridia and the absence of glands at the ectal orifice of the spermathecal duct. *F. giniata* and *F. alba* differ in the number of setae and the type of peptonephridia. These three species have a smaller spermathecal ampulla than *F. giniata*.

*Fridericia cylindrica* n.sp. (Fig. 3).

A medium sized species 10-15 mm long with 46-50 segments, grey-white in colour. Cutaneous glands in 1-5 rows per segment, very indistinct even in orcein stained specimens. Clitellum extends over XII-XIII, the glands not arranged

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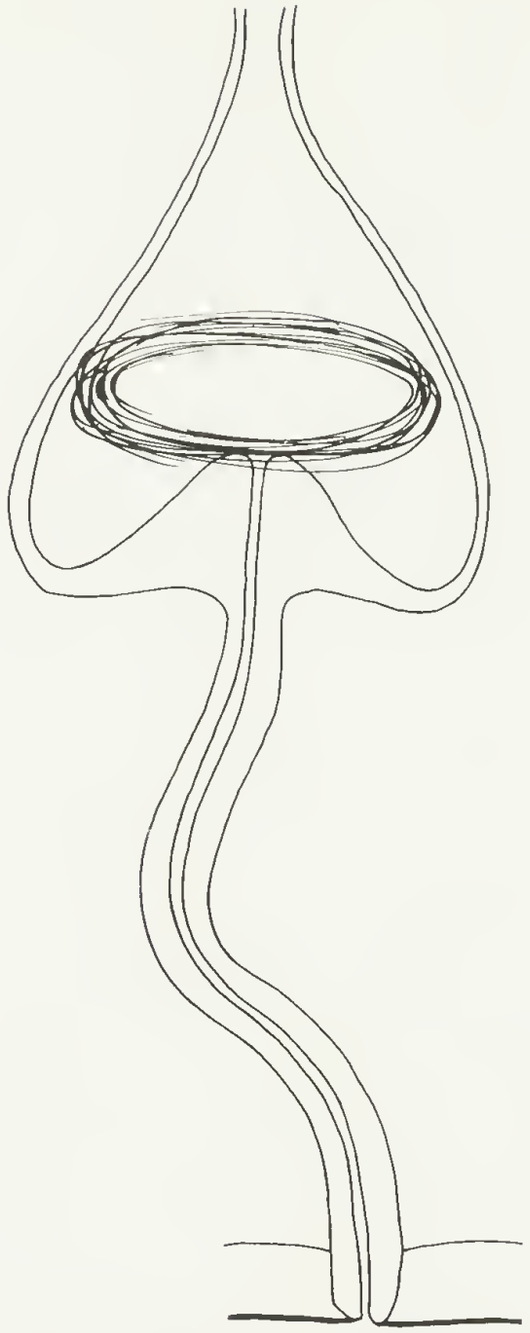

Figure 1—*Fridericia giniata* sp. nov.—spermatheca.

in rows. Setal bundles contain 2 distinctly hooked setae. Numerous detached setae in the coelom. Peptonephridia long, not coiled, with 2-4 terminal branches, sometimes extending as far back as segment VII. Dorsal vessel arises in XVII. Dorsal pores present from VII. Seminal vesicle present and well developed. Sperm funnel large, three to five times longer than broad, with a thick collar. Ectal duct of the nephridium medial. Spermatheca has two globular diverticula opening into a cylindrical ampulla. Ental ducts the same diameter as the ampullae, having separate wide openings into the lateral part of the oesophagus. One large stalked gland at the ectal orifice.

Chromosome number—unknown.

*Material examined:* 57 specimens of which 43 were mature.

*Distribution.*—Holotype and paratype collected from Site 3—Beedelup Brook, Lat. 34° 25′ S., long. 115° 51′ E. Holotype and paratype specimens deposited in the West Australian Museum (7-69, 8-69).

*Discussion.*—Of the small bisetose *Fridericia* species with two diverticula, *Fridericia cylindrica* can be most easily confused with *F. paroniana* Issel 1904. However, the shape of the spermatheca differs; in *F. cylindrica* the ectal duct is short and stout and the ectal gland is large, projecting into the coelom for a distance of about 30 $\mu$. The sperm funnels in *F. cylindrica* are unusual for the genus, being very long, 3-5 times longer than broad; in this character it resembles *F. regularis* Nielsen and Christensen 1959.

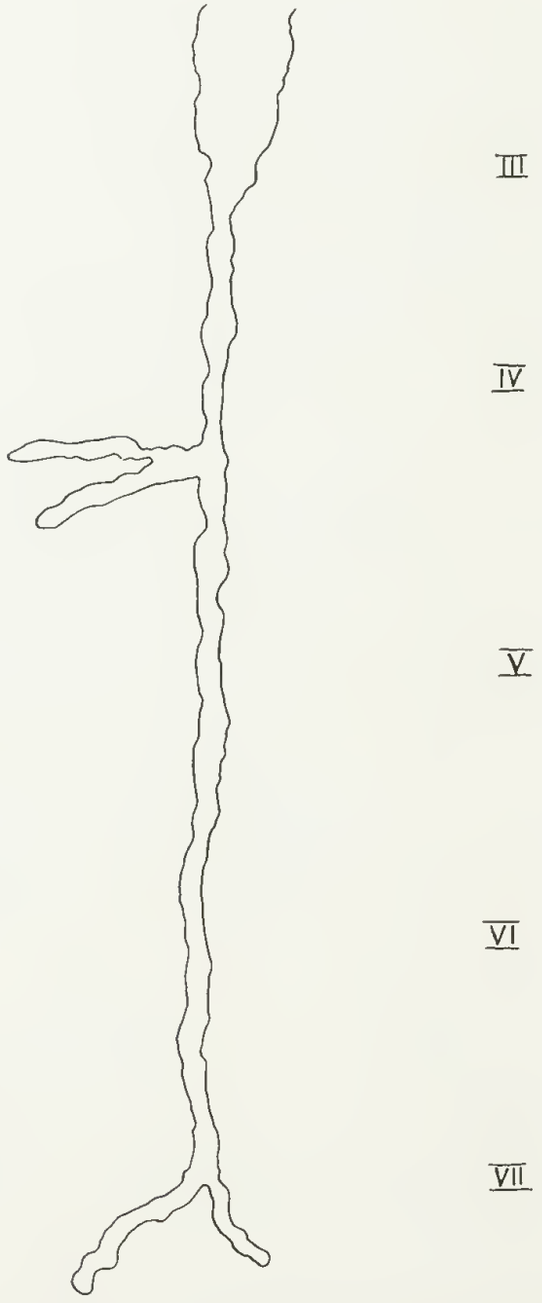


Figure 2—*Fridericia giniata* sp. nov.—peptonephridium.

Figure 3—*Fridericia cylindrica* sp. nov.—spermatheca.

*Fridericia holmesa* n.sp. (Figs. 4 and 5).

A medium sized worm, 10-15 mm long with 30-38 segments Cutaneous glands in 3-5 indistinct rows per segment. Clitellum extending over XII-½XIII, the glands not arranged in rows. Setal bundles containing two slightly hooked setae. Numerous packets of detached setae in the coelom. Peptonephridia long with 3-5 sub terminal branches, forming a conspicuous mass in segment IV or V. Dorsal vessel arising in segment XVII-XXII. Dorsal pores present from segment VI. Seminal vesicle present but not developed to such an extent that segments X-XI are distinctly red or brown. Sperm funnel 2-3 times longer than wide. Spermathecae with 2 diverticula and one, sometimes 2, small glands at the ectal orifice. The ental ducts merge and there is one opening into the mid dorsal part of the oesophagus at VI/VII.

Chromosome number—unknown.

*Material examined:* 62 specimens, all of which were mature.

*Distribution.*—Holotype and paratype from Site 3—Beedelup Brook, Lat. 34° 25′ S., long. 115° 51′ E. Holotype and paratype specimens are deposited in the West Australian Museum (7-69, 8-69).

**Discussion**

The ten species listed below have been described as having one spermathecal opening into the oesophagus.

| | |
|---|---|
| *F. connata* | Bretscher 1902 |
| *F. baskini* | Cernosvitov 1937 augm. Nielsen and Christensen 1959 |
| *F. gamotheca* | Issel 1904 |
| *F. caprensis* | Bell 1947 |
| *F. pretoriana* | Stephenson 1930 |
| *F berkeleyensis* | Bell 1936 |
| *F. losangelensis* | Bell 1936 |
| *F. variata* | Bretscher 1902 |
| *F. bulboides* | Nielsen and Christensen 1959. |

Of these species *F. caprensis, F. pretoriana, F. berkeleyensis, F. losangelensis, F. bulboides* and *F. variata* have no diverticula, *F. uniampullata* has a total of 7-9 diverticula and in *F. gamothecae* the ampullae are described as completely united into a spherical sac.

In *F. baskini* there are 4-7 preclitellar setae. *F. connata* is most similar to *F. holmesa* but can be distinguished from it by (1) the arrangement of the cutaneous and clitellar gland cells, distinct and regular in *F. connata,* indistinct and irregular in *F. holmesa*; (2) the peptonephridia which are very long in *F. holmesa* and are curled round to form a dense mass in segment IV or V; (3) the spermatheca which are of similar construction, but in *F. holmesa* only the ental ducts unite, not the ampullae, the opening into the oesophagus being in the rear part of segment VI. The gland at the ectal orifice is fairly large and in some specimens a a second gland has been noted.

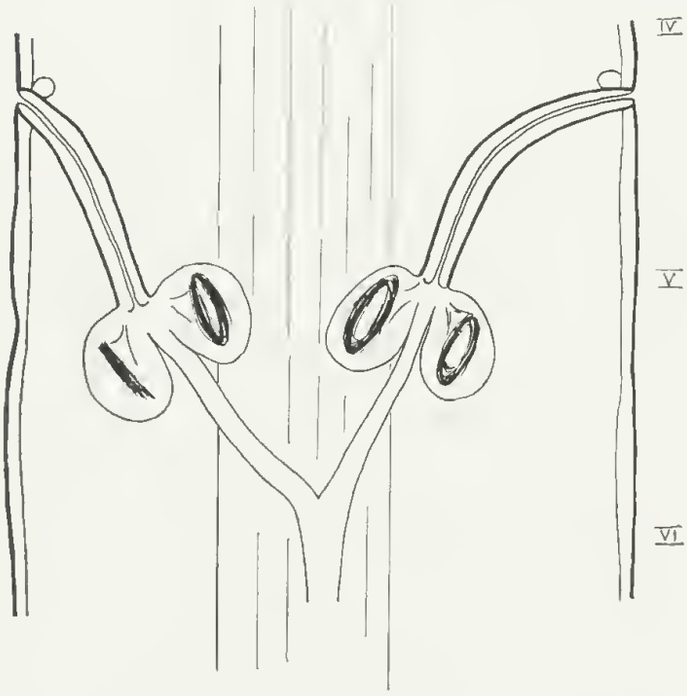


Figure 4—*Fridericia holmesa* sp. nov.—spermathecae.

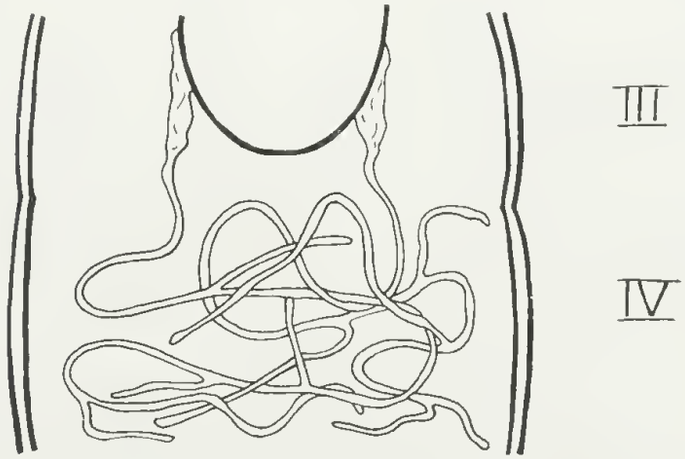


Figure 5—*Fridericia holmesa* sp. nov.—peptonephridia.

## New Australian Records

*Fridericia bulbosa* (Rosa) 1887 Nielsen and Christensen 1959.

A small bisetose worm, 8-10 mm long with 22-27 segments and a chromosome number of 32, was found at site 4. Thirty-five mature specimens were examined. The structure is identical with that of the Danish specimens described by Neilsen and Christensen 1959. The known distribution of this species is:

| | |
|---|---|
| Italy | (Rosa 1887, and Nielsen and Christensen 1963) |
| Armenia | (Cernosvitov 1941) |
| Denmark | (Nielsen and Christensen 1959) |
| Iceland | (Christensen 1962) |
| Norway | (Abrahamsen 1968) |
| Western Australia | (Springett). |

Specimens are deposited in the Western Australian State Museum (11-69).

*Fridericia bulboides* Nielsen and Christensen 1959.

Specimens of this species 8-12 mm long with 28-32 segments were also found at site 4. Twenty-eight mature specimens were examined. The species is essentially the same as that described by Nielsen and Christensen, having the characteristic peptonephridia with either a dense coil near the ectal duct of the spermatheca or a loop projecting forward into segment IV; in some specimens both loop and coil were present. The specimens found in Western Australia differ from the Danish specimens in having a fairly large, easily visible sessile gland at the ectal orifice of the spermathecal duct and in having no loose setae in the coelom. The chromosome number of the Australian specimens is unknown. The known distribution of the species is:

| | |
|---|---|
| Denmark | (Nielsen and Christensen 1959) |
| Sweden | (Nielsen and Christensen 1961) |
| Iceland | (Christensen 1962) |
| Finland | (Nurminen 1965) |
| Norway | (Abrahamsen 1968) |
| Western Australia | (Springett). |

Specimens are deposited in the Western Australian State Museum (12-69).

## General discussion

Of the six species of *Fridericia* recorded in Western Australia three are new to science and three have a European distribution. As all the *Fridericia* recorded have been found in or near agricultural areas, and the enehytraeid fauna of the European Mediterranean area is largely undescribed, it is not possible to say whether *F. giniata*, *F. holmesa* and *F. cylindrica* are endemic.

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# 4.—Skull and tooth variation in Australian bandicoots (Peramelidae, Marsupialia): the genus Isoodon and multivariate comparisons with Perameles

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**Abstract**

The morphological and metrical features of the skull and teeth of certain taxa of the genus *Isoodon* are described and analysed. Multivariate comparisons are then made between these and a number of *Perameles* taxa. The main multiple discriminant analyses, using either cranial or dental features alone, achieve good separation of the genera (principally on the 1st function), and of the lower taxa within each genus (mainly by the 2nd function).

## Introduction

This study is part of an ongoing investigation being made of skull and tooth variation in the bandicoots (Peramelidae: Marsupialia) of Australia. In a series of previous studies (Freedman, 1967; Freedman and Joffe 1967a and b), the anatomical and metrical features of the skull and teeth of species of the genus *Perameles*, the long-nosed bandicoots, were reported on. The present study utilises material from the major United States collections to examine the variations of the same features in certain species of the genus *Isoodon*, the short-nosed bandicoots. The main sample is of *I. macrourus*. In addition multivariate comparisons are made of the cranial and dental features of a number of taxa of *Isoodon* and *Perameles*. The usefulness of multivariate discriminant analysis in taxonomic studies is again apparent.

## Taxonomy of Isoodon

In most of the recent classifications of the genus *Isoodon* nine taxa are recognised. Thus, Tate (1948) and Marlow (1962) both list three species in the genus, the first two species each including a number of subspecies. The species they list are: *I. obesulus* (with 6 subspecies), *I. macrourus* (with 2 subspecies) and *I. barrowensis* (monotypic). For the same genus, Troughton (1957) delimits nine similar groups, but he describes *I. obesulus* as comprised of 3 subspecies and he regards the remaining 6 taxa as each being of full specific rank.

In the present study, a classification and distribution ranges similar to those outlined by Tate (1948) and Marlow (1962) will be used (Fig. 1). Thus, *I. obesulus* includes *I. o. obesulus* (southern half of coastal New South Wales, most of Victoria and an adjacent coastal portion of South Australia), *I. o. affinis* (Tasmania), *I. o. nauticus* (2 islands in the Nuyts Archipelago off the coast of South Australia), *I. o. fusciventer* (south west part of Western Australia), *I. o. auratus* (north east part of Western Australia and adjacent Northern Territory) and *I. o. peninsulae* (northern tip of Queensland). The species *I. macrourus* includes *I. m. macrourus* (northern part of Northern Territory) and *I. m. torosus* (east coast of Queensland and north half of the coast of New South Wales). The third species is *I. barrowensis* and its locality is Barrow Island, off the north west coast of Western Australia.

## Materials and Methods

The samples of the genus *Isoodon* assembled for the present study total 77 individuals and are from collections in the United States of America. They were kindly made available to us by the American Museum of Natural History and the Archbold Expeditions, New York (Dr. Hobart M. van Deusen), the Field Museum of Natural History, Chicago (Dr. William D. Turnbull) and the Smithsonian Institution, Washington (Dr. Henry W. Setzer). This material includes 24 specimens of *I. m. macrourus* (15 males and 9 females) and 38 specimens of *I. m. torosus* (24 males and 14 females). The sexes of a few of the *I. m. torosus* individuals were not recorded, and (on criteria discussed below) they were sexed on morphology and size. The number of *I. obesulus* specimens is only 14, and of these there are only 6 known males and 3 known females. The sample of this species includes individuals of *I. o. obesulus*, *I. o. affinis*, and *I. o. fusciventer*, but, because of the very small numbers, no attempt was made to treat these subspecies separately. Of *I. barrowensis* there is only a single specimen (Smithsonian Institution No. 218462). The whole of the available sample has been utilized for the morphological description and univariate analysis of *Isoodon*.

The main multivariate statistical tool used for comparing taxa was discriminant function analysis. Various aspects of the principles and methodology of the technique will be dealt with in the course of describing and discussing comparisons and results. Computation of the discriminants here reported was carried out at the University of Wisconsin Computer Center using a slightly modified version of program EIDISC (distributed by the Vogelback Computing Center, Northwestern University). This program provides output similar to that discussed in chapters 6 and 7 of Cooley and Lohnes (1962).

For the multivariate analyses utilizing the *Isoodon* data, the numbers in the various taxa had to be slightly reduced (Table 8) due to cer-

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